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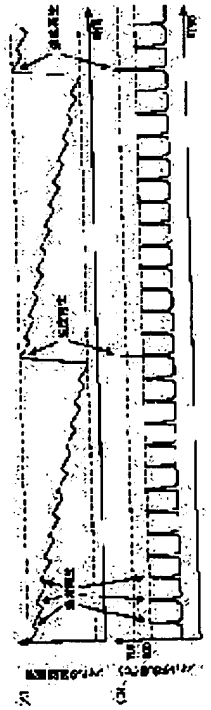
(54) EXHAUST EMISSION CONTROL DEVICE OF INTERNAL COMBUSTION ENGINE

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent the functional deterioration of a filter over a long period by completely removing a particle-like substance accumulated in the filter while restraining the thermal deterioration of the particulate filter.
SOLUTION: This exhaust emission control device is provided with the filter 20 for carrying a catalyst, and a filter temperature raising means 35 for raising a temperature of the filter. The filter temperature raising means 35 reduces a quantity of the particle-like substance by combustion by raising the temperature of the filter 20 up to a first prescribed temperature when a first prescribed condition is realized, raises the temperature of the filter 20 to a second prescribed



* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the exhaust emission control device which has the means which carries out uptake of particulate MATA (it is called "PM" unless it refuses below Particulate Matter especially.) represented by the soot which is the suspended particulate matter contained during exhaust air of a diesel power plant, concerning an internal combustion engine's exhaust emission control device.
[0002]
[Description of the Prior Art] While the diesel power plant is excellent in economical efficiency, it has been a technical problem with important removal of PM contained during exhaust air. For this reason, the technique of preparing the particulate filter (it only considering as a "filter" hereafter) which performs PM uptake in the exhaust air system of a diesel power plant so that PM may not be emitted into atmospheric air is common knowledge.
[0003] Uptake of the PM under exhaust air is once carried out with this filter. However, PM by which uptake was carried out is deposited on a filter, and generates the blinding of a filter. The pressure of exhaust air of the filter upstream rises by this blinding, and an internal combustion engine's loss of power and defamation of a filter are induced. Then, it will be necessary to remove PM and to prevent the blinding of a filter by carrying out ignition combustion of the PM by which uptake was carried out on the filter. Thus, it is called playback of a filter to remove PM.
[0004] However, in order to carry out ignition combustion of the PM by which uptake was carried out to said filter, an elevated temperature 500 degrees C or more is required, but since it is usually lower than this temperature, the temperature of exhaust air of a diesel power plant is difficult for combustion removal of PM.
[0005] According to [as opposed to / such a problem] JP,8-338230,A, the filter which supported the catalyst, and the equipment which supplies a hydrocarbon during exhaust air were used, and combustion of PM was enabled using the heat generated when burning with a catalyst the hydrocarbon supplied during exhaust air, with blinding is prevented.
[0006]
[Problem(s) to be Solved by the Invention] However, if it supplies in this way while exhausting a hydrocarbon, and a filter is changed into an elevated-temperature condition, the heat deterioration of a catalyst will be induced and it will become the cause of a fall of catalytic activity.
[0007] Here, although absorption of NOx in an NOx catalyst will be performed in the interface of Platinum Pt (catalyst matter) and Potassium K (NOx absorbent) if an occlusion reduction type NOx catalyst is explained to an example about heat deterioration, as for Pt, it is known in sintering by heat a lifting and that will grow up and particle size will become large. In purification of the exhaust air discharged by the internal combustion engine for cars, the thermal load which joins an NOx catalyst is large, and sintering of Platinum Pt cannot be avoided. Thus, if Platinum Pt causes sintering, the touch area of Platinum Pt and Potassium K will decrease, namely, the interface of Platinum Pt and Potassium

K will decrease. Consequently, the NOx absorptance of an NOx catalyst declines and NOx purification capacity declines. It is impossible to return to the condition before carrying out sintering of the Pt which caused sintering once, therefore an NOx catalyst cannot be recovered from heat deterioration.
[0008] In order to solve such a problem, when the amount of the hydrocarbon supplied during exhaust air is adjusted and the rise of whenever [catalyst temperature] is controlled, there is a possibility of burning and remaining, without promoting combustion of PM. In this case, although the heat deterioration of a catalyst can be prevented, there is a possibility that the blinding of a filter may occur in one side.
[0009] The technical problem which it is made in order that this invention may solve the above problem, and this invention tends to solve is in the exhaust emission control device of the internal combustion engine possessing the particulate filter which ****(ed) the catalyst to offer the technique in which the particulate matter deposited on the filter can be removed completely, controlling the heat deterioration of a filter, with it can continue at a long period of time, and the depression of a filter can be prevented.
[0010]
[Means for Solving the Problem] The following means was used for the exhaust emission control device of the internal combustion engine of this invention in order to attain the above-mentioned technical problem.
[0011] Namely, the filter with which the catalyst which uptake of the particulate matter which is prepared in an internal combustion engine's flueway and contained during exhaust air is carried out [catalyst], and promotes the combustion of particulate matter by which uptake was carried out was supported, A filter temperature rise means to raise the temperature of said filter is provided. Said filter temperature rise means When the first predetermined condition is satisfied, raise the temperature of a filter to the first predetermined temperature, and combustion loss in quantity of said particulate matter is carried out. Moreover, spacing which the temperature of a filter is raised to the second hot predetermined temperature rather than said first predetermined temperature when the second predetermined condition is satisfied, and is raised to said second predetermined temperature is characterized by the ******** rather than spacing raised to said first predetermined temperature.
[0012] Thus, in an internal combustion engine's constituted exhaust emission control device, uptake of the particulate matter contained during exhaust air is carried out with the filter prepared in the flueway. Since the particulate matter by which uptake was carried out is deposited in a filter and causes blinding of a filter, when the first predetermined condition is satisfied, the temperature of a filter rises with a filter temperature rise means, and deposited particulate matter carries out combustion loss in quantity of it. In order to heat-deteriorate if a filter becomes an elevated temperature at this time, and for a catalyst function to fall, filter temperature is made into the first predetermined temperature of about 500 degrees C, and heat deterioration is prevented.
[0013] However, the particulate matter which deposited particulate matter may burn with this first predetermined temperature, may remain, and remains in this way has a possibility of an amount increasing gradually and generating the blinding of a filter.
[0014] Then, in the invention in this application, when the second predetermined condition was satisfied, we decided to carry out the temperature rise of the filter to an elevated temperature, for example, the second predetermined temperature of about 700 degrees C, and to carry out combustion removal of the particulate matter completely rather than the first predetermined temperature.
[0015] Thus, when filter temperature is raised to the second predetermined temperature, there is a possibility of inducing the heat deterioration of a catalyst. Then, the fall of a catalyst function is controlled by setting up the first and the second condition so that it may become longer than what makes it shorter than the period which is carrying out the temperature up of the period which is carrying out the temperature up of the filter to the second predetermined temperature to the first predetermined temperature, and depends temperature rise spacing of the filter by the second predetermined condition formation on the first predetermined condition formation.
[0016] It can illustrate that the car ran a predetermined distance as first predetermined condition used as the conditions when raising filter temperature to the first predetermined temperature, that the discharge

of the particulate matter computed from an internal combustion engine's load and rotational frequency reached the specified quantity, etc.
[0017] moreover, as second predetermined condition used as the conditions when raising the second predetermined temperature, filter temperature It can illustrate having raised the filter to the first predetermined temperature and having performed combustion loss in quantity of particulate matter the number of predetermined times or that the car ran a predetermined distance, that the discharge of the particulate matter computed from an internal combustion engine's load and rotational frequency reached the specified quantity, etc.
[0018] Thus, combustion loss in quantity of the particulate matter can be carried out, usually raising filter temperature to the first predetermined temperature, and preventing heat deterioration.
[0019] Moreover, since the temperature rise of the filter is carried out to the second hot predetermined temperature rather than the first predetermined temperature at long spacing, the early depression of a catalyst can be prevented, carrying out combustion removal of the particulate matter which remained completely.
[0020] The approach of heating a filter directly using a heater etc. can illustrate at the stage not to become an engine output after the main injection which makes the fuel for an engine output inject into the approach of supplying a reducing agent to the filter upstream as a filter temperature rise means by the nozzle prepared in the flueway , and an internal combustion engine gas column from the approach using the subinjection (it is also call postinjection) which makes a fuel inject again (like for example , an expansion line) , and the exterior .
[0021] As a catalyst which a filter is made to support, an occlusion reduction type NOx catalyst, a selection reduction type NOx catalyst, an oxidation catalyst, etc. can be illustrated.
[0022] A particulate filter can be illustrated as a filter.
[0023]
[Embodiment of the Invention] Hereafter, the concrete embodiment of the exhaust emission control device of the internal combustion engine concerning this invention is explained based on a drawing. Here, the case where the exhaust emission control device concerning this invention is applied to the Diesel engine for a car drive is mentioned as an example, and is explained.
[0024] Drawing 1 is drawing showing the outline configuration of the internal combustion engine which applies the exhaust emission control device concerning this invention, and its pumping system.
[0025] The internal combustion engine 1 which shows drawing 1 is a four-cycle Diesel engine of a water cooling type which has four gas columns 2.
[0026] The internal combustion engine 1 equips the combustion chamber of each gas column 2 with the fuel injection valve 3 which injects a direct fuel. Each fuel injection valve 3 is connected with the accumulator (common rail) 4 which accumulates a fuel to place constant pressure. Common-rail-pressure sensor 4a which outputs the electrical signal corresponding to the pressure of the fuel in this common rail 4 is attached in this common rail 4.
[0027] Said common rail 4 is open for free passage with the fuel pump 6 through a fuel feeding pipe 5. This fuel pump 6 is a pump which operates considering the running torque of an internal combustion engine's 1 output shaft (crankshaft) as a driving source, and pump pulley 6a attached in the input shaft of this fuel pump 6 is connected through crank-pulley 1a and the belt 7 which were attached in an internal combustion engine's 1 output shaft (crankshaft).
[0028] Thus, in the constituted fuel-injection system, if the running torque of a crankshaft is transmitted to the input shaft of a fuel pump 6, a fuel pump 6 will carry out the regurgitation of the fuel by the pressure according to the running torque transmitted to the input shaft of this fuel pump 6 from the crankshaft.
[0029] A common rail 4 is supplied through a fuel feeding pipe 5, pressure is accumulated to place constant pressure with a common rail 4, and the fuel breathed out from said fuel pump 6 is distributed to the fuel injection valve 3 of each gas column 2. And if a drive current is impressed to a fuel injection valve 3, a fuel injection valve 3 will open, consequently a fuel will be injected into a gas column 2 from a fuel injection valve 3.

[0030] Next, the inhalation-of-air branch pipe 8 is connected to the internal combustion engine 1, and each branch pipe of the inhalation-of-air branch pipe 8 is open for free passage through the combustion chamber of each gas column 2, and the suction port which is not illustrated.
[0031] Said inhalation-of-air branch pipe 8 is connected to an inlet pipe 9, and this inlet pipe 9 is connected to the air cleaner box 10. The air flow meter 11 which outputs the electrical signal corresponding to the mass of the inhalation of air which circulates the inside of this inlet pipe 9 to the down-stream inlet pipe 9, and the inhalation-of-air temperature sensor 12 which outputs the electrical signal corresponding to the temperature of the inhalation of air which circulates the inside of this inlet pipe 9 are attached from said air cleaner box 10.
[0032] The inhalation-of-air throttle valve 13 which adjusts the flow rate of the inhalation of air which circulates the inside of this inlet pipe 9 is formed in the part in which it is located in the style of [of the inhalation-of-air branch pipe 8 in said inlet pipe 9] right above. The actuator 14 for an inhalation-of-air diaphragm which consists of stepper motors etc. and carries out the closing motion drive of this inhalation-of-air throttle valve 13 is attached in this inhalation-of-air throttle valve 13.
[0033] Compressor housing 15a of the centrifugal supercharger (turbocharger) 15 which operates considering the heat energy of exhaust air as a driving source is prepared in the inlet pipe 9 located between said air flow meters 11 and said inhalation-of-air throttle valves 13, and the intercooler 16 for cooling the inhalation of air which was compressed into the down-stream inlet pipe 9 within said compressor housing 15a, and became an elevated temperature from compressor housing 15a is formed in it.
[0034] Thus, by the constituted inhalation-of-air system, the inhalation of air which flowed into the air cleaner box 10 flows into compressor housing 15a through an inlet pipe 9, after dust, dust, etc. under inhalation of air are removed by the air cleaner which is not illustrated in this air cleaner box 10.
[0035] The inhalation of air which flowed into compressor housing 15a is compressed by the rotation of a compressor wheel by which interior was carried out to this compressor housing 15a. After being cooled by the intercooler 16, if needed, by the inhalation-of-air throttle valve 13, the inhalation of air which was compressed within said compressor housing 15a, and became an elevated temperature has a flow rate adjusted, and flows into the inhalation-of-air branch pipe 8. The inhalation of air which flowed into the inhalation-of-air branch pipe 8 is distributed to the combustion chamber of each gas column 2 through each branch pipe, and burns considering the fuel injected from the fuel injection valve 3 of each gas column 2 as an ignition source.
[0036] On the other hand, the exhaust air branch pipe 18 is connected to an internal combustion engine 1, and it is open for free passage with the combustion chamber of each gas column 2 through the exhaust air port which each branch pipe of the exhaust air branch pipe 18 does not illustrate.
[0037] Said exhaust air branch pipe 18 is connected with turbine housing 15b of said centrifugal supercharger 15. Said turbine housing 15b is connected with an exhaust pipe 19, and this exhaust pipe 19 is connected to the muffler which is not illustrated on a lower stream of a river.
[0038] In the middle of said exhaust pipe 19, the particulate filter 20 which supported the occlusion reduction type NOx catalyst is arranged. The air-fuel ratio sensor 23 which outputs the electrical signal corresponding to the air-fuel ratio of the exhaust air which circulates the inside of this exhaust pipe 19 to the down-stream exhaust pipe 19, and the exhaust air temperature sensor 24 which outputs the electrical signal corresponding to the temperature of the exhaust air which circulates the inside of this exhaust pipe 19 are attached from the filter 20.
[0039] The exhaust air throttle valve 21 which adjusts the flow rate of the exhaust air which circulates the inside of this exhaust pipe 19 is formed in the down-stream exhaust pipe 19 from the above mentioned air-fuel ratio sensor 23 and the above mentioned exhaust air temperature sensor 24. The actuator 22 for an exhaust air diaphragm which consists of stepper motors etc. and carries out the closing motion drive of this exhaust air throttle valve 21 is attached in this exhaust air throttle valve 21.
[0040] Thus, by the constituted exhaust air system, the gaseous mixture (burnt gas) which burned in each gas column 2 of an internal combustion engine 1 is discharged through an exhaust air port to the exhaust air branch pipe 18, and, subsequently flows into turbine housing 15b of a centrifugal

supercharger 15 from the exhaust air branch pipe 18. The exhaust air which flowed into turbine housing 15b rotates the turbine wheel supported free [rotation] in turbine housing 15b using the heat energy which this exhaust air has. The running torque of a turbine wheel is transmitted to the compressor wheel of compressor housing 15a mentioned above in that case.

[0041] The exhaust air discharged from said turbine housing 15b flows into a filter 20 through an exhaust pipe 19, and uptake of the PM under exhaust air is carried out, and a harmful gas component is removed or purified. After the exhaust air which uptake was carried out in PM with the filter 20, and was removed or purified in the harmful gas component has a flow rate adjusted by the exhaust air throttle valve 21 if needed, it is emitted into atmospheric air through a muffler.

[0042] Moreover, the exhaust air branch pipe 18 and the inhalation-of-air branch pipe 8 are opened for free passage through the exhaust-gas-recirculation path (EGR path) 25 which carries out recycling of a part of exhaust air which circulates the inside of the exhaust air branch pipe 18 to the inhalation-of-air branch pipe 8. In the middle of this EGR path 25, it consists of solenoid valves etc. and the flow control valve (EGR valve) 26 which changes the flow rate of the exhaust air (EGR gas is called hereafter) which circulates the inside of said EGR path 25 according to the magnitude of impression power is formed.

[0043] At said EGR path 25, EGR cooler 27 which cools the EGR gas which circulates the inside of this EGR path 25 is formed in the upstream part from the EGR valve 26.

[0044] Thus, by the constituted exhaust-gas-recirculation device, if the EGR valve 26 is opened, the EGR path 25 will be in switch-on, a part of exhaust air which circulates the inside of the exhaust air branch pipe 18 will flow into said EGR path 25, and it will be led to the inhalation-of-air branch pipe 8 through EGR cooler 27.

[0045] In that case, by EGR cooler 27, heat exchange will be performed between the EGR gas which circulates the inside of the EGR path 25, and a predetermined refrigerant, and EGR gas will be cooled.

[0046] It is led to the combustion chamber of each gas column 2, the EGR gas which flowed back from the exhaust air branch pipe 18 to the inhalation-of-air branch pipe 8 through the EGR path 25 being mixed with new mind of having flowed from the upstream of the inhalation-of-air branch pipe 8, and burns considering the fuel injected from a fuel injection valve 3 as an ignition source.

[0047] since the inert gas component which oneself does not burn and has endoergic nature like water (H2O) or a carbon dioxide (CO2) is contained in EGR gas here -- EGR gas -- gaseous mixture -- if contained in inside, the combustion temperature of gaseous mixture can lower, with the yield of nitrogen oxides (NOx) will be controlled.

[0048] Furthermore, while it is lost that the ambient temperature of this combustion chamber rises unnecessarily when EGR gas is supplied to a combustion chamber since the volume of EGR gas will be reduced while the temperature of EGR gas itself falls if EGR gas is cooled in EGR cooler 27, the amount (volume of new mind) of the new mind supplied to a combustion chamber does not decrease unnecessarily.

[0049] Next, the filter 20 concerning the gestalt of this operation is explained.

[0050] The structure of a filter 20 is shown in drawing 4 . In addition, in drawing 4 , (A) shows the longitudinal direction cross section of a filter 20, and (B) shows the lengthwise direction sectional view of a filter 20. As shown in drawing 4 (A) and (B), a filter 20 is the so-called Wall flow mold possessing two or more exhaust air circulation ways 50 and 51 which are mutually parallel and extend. These exhaust air circulation way is constituted by the exhaust air inflow path 50 where the down-stream edge was blockaded with the plug 52, and the exhaust air outflow path 51 where the upper edge was blockaded with the plug 53. In addition, the part which attached hatching in drawing 4 (A) shows the plug 53. Therefore, the exhaust air inflow path 50 and the exhaust air outflow path 51 are arranged by turns through the septum 54 of thin meat. A paraphrase arranges the exhaust air inflow path 50 and the exhaust air outflow path 51 so that each exhaust air inflow path 50 may be surrounded by four exhaust air outflow paths 51 and each exhaust air outflow path 51 may be surrounded by four exhaust air inflow paths 50.

[0051] A filter 20 flows out for example, in the exhaust air outflow path 51 which adjoins through the inside of the surrounding septum 54 as the exhaust air which is formed from a porous material like a

cordylite, therefore flowed in the exhaust air inflow path 50 is shown by the arrow head in drawing 4 (B).

[0052] In the example by this invention, the layer of the support which consists of an alumina is formed on the pore internal surface on the peripheral wall side of each exhaust air inflow path 50 and each exhaust air outflow path 51, i.e., the both-sides front face of each septum 54, and in a septum 54, and the occlusion reduction type NOx catalyst is ****(ed) on this support.

[0053] Next, work of the occlusion reduction type NOx catalyst supported by the filter 20 concerning the gestalt of this operation is explained.

[0054] An alumina is made into support, and a filter 20 supports at least one chosen from alkali metal, such as a potassium (K), sodium (Na), a lithium (Li), or caesium (Cs), alkaline earths, such as barium (Ba) or calcium (calcium), and rare earth, such as a lanthanum (La) or an yttrium (Y), on the support, and noble metals, such as platinum (Pt), and is constituted. In addition, the occlusion reduction type NOx catalyst which consists of gestalten of this operation by supporting barium (Ba) and platinum (Pt) on the support which consists of an alumina is mentioned as an example, and is explained.

[0055] Thus, when the constituted NOx catalyst has the high oxygen density of the exhaust air which flows into this NOx catalyst, the nitrogen oxides (NOx) under exhaust air are absorbed.

[0056] On the other hand, an NOx catalyst emits the nitrogen oxides (NOx) which were being absorbed, when the oxygen density of the exhaust air which flows into this NOx catalyst falls. If reduction components, such as a hydrocarbon (HC) and a carbon monoxide (CO), exist during exhaust air in that case, an NOx catalyst can make nitrogen (N2) return the nitrogen oxides (NOx) emitted from this NOx catalyst.

[0057] In addition, although there is also a part which is not clarified about the NOx absorption/emission action of an NOx catalyst, it is thought that it is performed by the about following mechanisms.

[0058] First, in an NOx catalyst, if the air-fuel ratio of the exhaust air which flows into this NOx catalyst turns into the Lean air-fuel ratio and the oxygen density under exhaust air increases, as shown in drawing 2 (A), the oxygen under exhaust air (O2) will adhere on the front face of platinum (Pt) in the form of O2- or O2-. The nitrogen monoxide under exhaust air (NO) reacts with O2- or O2- on the front face of platinum (Pt), and forms a nitrogen dioxide (NO2) (2 NO+O2 ->2NO2). A nitrogen dioxide (NO2) oxidizes further on the front face of platinum (Pt), and is absorbed by the NOx catalyst in the form of nitrate ion (NO3-). In addition, it combines with the barium oxide (BaO) and the nitrate ion (NO3-) absorbed by the NOx catalyst forms a barium nitrate (Ba2 (NO3)).

[0059] Thus, when the air-fuel ratio of the exhaust air which flows into an NOx catalyst is the Lean air-fuel ratio, the nitrogen oxides (NOx) under exhaust air are absorbed by the NOx catalyst as nitrate ion (NO3-).

[0060] The air-fuel ratio of inflow exhaust air is the Lean air-fuel ratio, and NOx absorption which was described above is continued unless the NOx absorptance of an NOx catalyst is saturated. Therefore, when the air-fuel ratio of the exhaust air which flows into an NOx catalyst is the Lean air-fuel ratio, unless the NOx absorptance of an NOx catalyst is saturated, the nitrogen oxides (NOx) under exhaust air will be absorbed by the NOx catalyst, and nitrogen oxides (NOx) will be removed out of exhaust air.

[0061] On the other hand, with an NOx catalyst, if the oxygen density of the exhaust air which flows into this NOx catalyst falls, in order that the amount of generation of a nitrogen dioxide (NO2) may decrease on the front face of platinum (Pt), the nitrate ion (NO3-) combined with the barium oxide (BaO) serves as a nitrogen dioxide (NO2) and a nitrogen monoxide (NO) conversely, and it secedes from an NOx catalyst.

[0062] If reduction components, such as a hydrocarbon (HC) and a carbon monoxide (CO), exist during exhaust air in that case, those reduction components will react partially with the oxygen (O2- or O2-) on platinum (Pt), and will form active species. This active species makes nitrogen (N2) return the nitrogen dioxide (NO2) and nitrogen monoxide (NO) which were emitted from the NOx catalyst.

[0063] Therefore, while the air-fuel ratio of the exhaust air which flows into an NOx catalyst turns into theoretical air fuel ratio or a rich air-fuel ratio and the oxygen density under exhaust air falls, when the concentration of a reducing agent increases, the nitrogen oxides (NOx) absorbed by the NOx catalyst

will be emitted and returned, with the NOx absorptance of an NOx catalyst will be reproduced.
[0064] By the way, although the nitrogen oxides (NOx) contained during exhaust air will be absorbed by the NOx catalyst since the air-fuel ratio of the exhaust air discharged by the internal combustion engine 1 serves as lean atmosphere and the oxygen density of exhaust air becomes high when lean combustion operation of the internal combustion engine 1 is carried out If lean combustion operation of an internal combustion engine 1 is continued for a long period of time, the NOx absorptance of an NOx catalyst will be saturated and it will be emitted into atmospheric air, without removing the nitrogen oxides (NOx) under exhaust air with an NOx catalyst.
[0065] Since the gaseous mixture of the Lean air-fuel ratio burns in most operating range and the air-fuel ratio of exhaust air turns into the Lean air-fuel ratio in most operating range according to it, the NOx absorptance of an NOx catalyst tends [especially] to be saturated with a Diesel engine like an internal combustion engine 1.
[0066] Therefore, when lean combustion operation of the internal combustion engine 1 is carried out, it is necessary to raise the concentration of a reducing agent, while reducing the oxygen density under exhaust air which flows into an NOx catalyst before the NOx absorptance of an NOx catalyst is saturated, and to make the nitrogen oxides (NOx) absorbed by the NOx catalyst emit and return.
[0067] By having the reducing-agent feeder style which adds a reducing-agent slack fuel (gas oil) during the exhaust air which circulates an upstream flueway, and adding a fuel into exhaust air from this reducing-agent feeder style from a filter 20, the exhaust emission control device of the internal combustion engine concerning the gestalt of this operation raised the concentration of a reducing agent while reducing the oxygen density of the exhaust air which flows into a filter 20.
[0068] The reducing-agent injection valve 28 which a reducing-agent feeder style opens when it is attached in an internal combustion engine's 1 cylinder head so that the nozzle hole may face in the exhaust air branch pipe 18 and the fuel more than a predetermined injection-valve opening pressure is impressed, as shown in drawing 1 , and injects a fuel, The reducing-agent supply way 29 which leads the fuel breathed out from the fuel pump 6 mentioned above to said reducing-agent injection valve 28, The flow control valve 30 which adjusts the flow rate of the fuel which is prepared in the middle of this reducing-agent supply way 29, and circulates the inside of this reducing-agent supply path 29, The latching valve 31 which is prepared in the upstream reducing-agent supply way 29, and intercepts circulation of the fuel in this reducing-agent supply way 29 from this flow control valve 30, It has the reducing-agent pressure sensor 32 which is attached in the upstream reducing-agent supply way 29 from said flow control valve 30, and outputs the electrical signal corresponding to the pressure in this reducing-agent supply way 29.
[0069] In addition, as for the reducing-agent injection valve 28, it is desirable to be attached in the cylinder head from a connection part with the EGR path [in / in the nozzle hole of this reducing-agent injection valve 28 / the exhaust air branch pipe 18] 25, so that the set section of the exhaust air branch pipe 18 may be turned to while projecting in the exhaust air port of the gas column 2 nearest to [are a lower stream of a river and] the set section of four branch pipes in the exhaust air branch pipe 18.
[0070] This is for making it reach to turbine housing 15b of a centrifugal supercharger, without a reducing agent being overdue in the exhaust air branch pipe 18 while the reducing agent (fuel component of non-**) injected from the reducing-agent injection valve 28 prevents flowing into the EGR path 25.
[0071] In addition, although the reducing-agent injection valve 28 is attached in the exhaust air port of the No. 1 (#1) gas column 2 in the example shown in drawing 1 since the No. 1 (#1) gas column 2 is in the set section of the exhaust air branch pipe 18, and the nearest location among four gas columns 2 of an internal combustion engine 1 When gas columns 2 other than No. 1 (#1) gas column 2 are in the set section of the exhaust air branch pipe 18, and the nearest location, the reducing-agent injection valve 28 is attached in the exhaust air port of the gas column 2.
[0072] Moreover, said reducing-agent injection valve 28 approaches penetration or a water jacket, the water jacket which was formed in the cylinder head and which is not illustrated is attached, and the reducing-agent injection valve 28 may be made to be cooled using the cooling water which circulates

said water jacket.
[0073] At such reducing-agent feeder guard, valve opening of a flow control valve 30 impresses the high-pressure fuel breathed out from the fuel pump 6 through the reducing-agent supply way 29 to the reducing-agent injection valve 28. And if the pressure of the fuel impressed to the reducing-agent injection valve 28 reaches more than an injection-valve opening pressure, this reducing-agent injection valve 28 will open, and the fuel as a reducing agent will be injected into the exhaust air branch pipe 18.
[0074] the exhaust air with which the reducing agent injected into the exhaust air branch pipe 18 from the reducing-agent injection valve 28 has flowed from the upstream of the exhaust air branch pipe 18 -- ** -- it both flows into turbine housing 15b. It is agitated by rotation of a turbine wheel, homogeneity is mixed, and the exhaust air and the reducing agent which flowed in turbine housing 15b form exhaust air of a rich air-fuel ratio.
[0075] Thus, exhaust air of the formed rich air-fuel ratio flows into a filter 20 through an exhaust pipe 19 from turbine housing 15b, and it will be returned to nitrogen (N2), making the nitrogen oxides (NOx) absorbed by the filter 20 emit.
[0076] Then, when clausilium of the flow control valve 30 is carried out and supply of the reducing agent from the fuel pump 6 to the reducing-agent injection valve 28 is intercepted, the pressure of the fuel impressed to the reducing-agent injection valve 28 becomes said under injection-valve opening pressure, consequently the reducing-agent injection valve 28 will close the valve, and addition of the reducing agent into the exhaust air branch pipe 18 will be stopped.
[0077] The electronic control unit (ECU:Electronic Control Unit) 35 for controlling this internal combustion engine 1 is put side by side in the internal combustion engine 1 constituted as stated above. This ECU35 is a unit which controls an internal combustion engine's 1 operational status according to an internal combustion engine's 1 service condition, or a demand of an operator.
[0078] Common-rail-pressure sensor 4a, an air flow meter 11, the inhalation-of-air temperature sensor 12, the pressure-of-induction-pipe force sensor 17, the air-fuel ratio sensor 23, the exhaust air temperature sensor 24, the reducing-agent pressure sensor 32, the crank position sensor 33, a coolant temperature sensor 34, and the various sensors of accelerator opening sensor 36 grade are connected to ECU35 through electric wiring, and the output signal of the various above-mentioned sensors is inputted into ECU35.
[0079] On the other hand, it enables ECU35 to control each part which connected through electric wiring and a fuel injection valve 3, the actuator 14 for an inhalation-of-air diaphragm, the actuator 22 for an exhaust air diaphragm, the EGR valve 26, the flow control valve 30, and the latching valve 31 grade described above at ECU35.
[0080] Here, ECU35 is equipped with A/D converter (A/D) 355 connected to said input port 356 while it is equipped with CPU351, ROM352 and RAM353, the backup RAM 354 and input port 356 that were mutually connected by the bidirectional bus 350, and an output port 357, as shown in drawing 3 .
[0081] Said input port 356 inputs the output signal of the sensor which outputs the signal of a digital signal format like the crank position sensor 33, and transmits those output signals to CPU351 or RAM353.
[0082] Said input port 356 is inputted through A/D355 of the sensor which outputs the signal of an analog signal format like in common-rail-pressure sensor 4a, an air flow meter 11, the inhalation-of-air temperature sensor 12, the pressure-of-induction-pipe force sensor 17, the air-fuel ratio sensor 23, the exhaust air temperature sensor 24, the reducing-agent pressure sensor 32, a coolant temperature sensor 34, the accelerator opening sensor 36, etc., and transmits those output signals to CPU351 or RAM353.
[0083] It connects with a fuel injection valve 3, the actuator 14 for an inhalation-of-air diaphragm, the actuator 22 for an exhaust air diaphragm, the EGR valve 26, a flow control valve 30, and latching valve 31 grade through electric wiring, and said output port 357 transmits the control signal outputted from CPU351 to the above mentioned fuel injection valve 3, the actuator 14 for an inhalation-of-air diaphragm, the actuator 22 for an exhaust air diaphragm, the EGR valve 26, a flow control valve 30, or a latching valve 31.
[0084] Said ROM352 has memorized application programs, such as a poisoning dissolution control

routine for canceling PM combustion control routine for carrying out combustion removal of the PM by which uptake was carried out to the EGR control routine for controlling the exhaust air diaphragm control routine for controlling the inhalation-of-air diaphragm control routine for controlling the fuel-injection control routine for controlling a fuel injection valve 3, and the inhalation-of-air throttle valve 13, and the exhaust air throttle valve 21, and the EGR valve 26, and the filter 20, and poisoning by the oxide of a filter 20.

[0085] In addition to the above-mentioned application program, said ROM352 has memorized various kinds of control maps. Said control map For example, the fuel-oil-consumption control map in which the relation between an internal combustion engine's 1 operational status and basic fuel oil consumption (basic fuel injection duration) is shown, The fuel-injection-timing control map in which the relation between an internal combustion engine's 1 operational status and basic fuel injection timing is shown, The inhalation-of-air throttle valve opening control map in which the relation between an internal combustion engine's 1 operational status and the target opening of the inhalation-of-air throttle valve 13 is shown, The exhaust air throttle valve opening control map in which the relation between an internal combustion engine's 1 operational status and the target opening of the exhaust air throttle valve 21 is shown, It is the target addition (or) of the operational status of a control map and an internal combustion engine 1, and a reducing agent whenever [EGR valve-opening / which shows the relation between an internal combustion engine's 1 operational status, and the target opening of the EGR valve 26]. They are the reducing-agent addition control map in which relation with the target air-fuel ratio of exhaust air is shown, the flow control valve control map in which the relation between the target addition of a reducing agent and the valve-opening time amount of a flow control valve 30 is shown.

[0086] Said RAM353 stores the output signal from each sensor, the result of an operation of CPU351, etc. Said result of an operation is an engine rotational frequency by which the crank position sensor 33 is computed based on time spacing which outputs a pulse signal. These data are rewritten by the newest data whenever the crank position sensor 33 outputs a pulse signal.

[0087] Said backup RAM 354 is the memory of the non-volatile after an internal combustion engine's 1 shutdown can remember data to be.

[0088] Said CPU351 operates according to the application program memorized by said ROM352, and performs fuel injection valve control, inhalation-of-air throttling control, exhaust air throttling control, EGR control, PM combustion control, poisoning dissolution control, etc.

[0089] For example, in fuel injection valve control, CPU351 determines first the fuel quantity injected from a fuel injection valve 3, and determines the stage to inject a fuel from a fuel injection valve 3 subsequently.

[0090] When determining fuel oil consumption, CPU351 reads the engine rotational frequency memorized by RAM353 and the output signal (accelerator opening) of the accelerator opening sensor 36. CPU351 is accessed to a fuel-oil-consumption control map, and computes said engine rotational frequency and the basic fuel fuel oil consumption (basic fuel injection duration) corresponding to said accelerator opening. CPU351 amends said basic fuel injection duration based on the output signal value of an air flow meter 11, the inhalation-of-air temperature sensor 12, and coolant temperature sensor 34 grade etc., and determines final fuel injection duration.

[0091] When determining fuel injection timing, CPU351 is accessed to a fuel-injection initiation stage control map, and computes the basic fuel injection timing corresponding to said engine rotational frequency and said accelerator opening. CPU351 amends said basic fuel injection timing by making the output signal value of an air flow meter 11, the inhalation-of-air temperature sensor 12, and coolant temperature sensor 34 grade into a parameter, and determines final fuel injection timing.

[0092] If fuel injection duration and fuel injection timing are determined, CPU351 compares said fuel injection timing and output signal of the crank position sensor 33, and when the output signal of said crank position sensor 33 is in agreement with said fuel-injection initiation stage, it will start the impression of drive power to a fuel injection valve 3. CPU351 stops the impression of drive power to a fuel injection valve 3, when the elapsed time from the time of starting the impression of drive power to a fuel injection valve 3 reaches said fuel injection duration.

[0093] In addition, when an internal combustion engine's 1 operational status is in idle operational status in fuel-injection control, CPU351 computes an internal combustion engine's 1 target idle rpm by making into a parameter the output signal value of a coolant temperature sensor 34, the operating state of the auxiliary machinery which operate like the compressor of the air conditioner for the vehicle interior of a room using the turning effort of a crankshaft, etc. And CPU351 carries out feedback control of the fuel oil consumption so that actual idle rpm may be in agreement with target idle rpm.
[0094] Moreover, in inhalation-of-air throttling control, CPU351 reads the engine rotational frequency and accelerator opening which are memorized by RAM353. CPU351 is accessed to an inhalation-of-air throttle valve opening control map, and computes the target inhalation-of-air throttle valve opening corresponding to an engine rotational frequency and accelerator opening. CPU351 impresses the drive power corresponding to said target inhalation-of-air throttle valve opening to the actuator 14 for an inhalation-of-air diaphragm. In that case, CPU351 detects the actual opening of the inhalation-of-air throttle valve 13, and may be made to carry out feedback control of said actuator 14 for an inhalation-of-air diaphragm based on the difference of the opening of the actual inhalation-of-air throttle valve 13, and target inhalation-of-air throttle valve opening.
[0095] Moreover, CPU351 controls the actuator 22 for an exhaust air diaphragm by exhaust air throttling control that the exhaust air throttle valve 21 should be driven in the direction of clausilium, when an internal combustion engine 1 is in the warming-up operational status after starting between the colds, or when the heater for the vehicle interior of a room is in an operating state.
[0096] in this case, an internal combustion engine's 1 load increases and the quantity of fuel oil consumption is increased corresponding to it -- things -- ** Consequently, while an internal combustion engine's 1 calorific value increases and an internal combustion engine's 1 warming up is promoted, the heat source of the heater for the vehicle interior of a room is secured.
[0097] Next, PM combustion control used as the summary of this invention is explained.
[0098] Drawing 5 (A) is drawing showing the path area of the filter 20 which changes with time amount. Moreover, drawing 5 (B) is drawing having shown the floor tempereture of the filter 20 corresponding to drawing 5 (A). Here, the path area of a filter 20 is the area of the gap when passing the septum 54 by which exhaust air is shown in drawing 4 (B).
[0099] Temperature up control of a filter was performed with the gestalt of this operation, having made first predetermined temperature into 600 degrees C or less, and having used second predetermined temperature as 700 degrees C or more. Moreover, it is called "playback on the strength" that call it "Usually reproducing" to carry out the temperature up of the filter 20 to the first predetermined temperature, and it carries out a temperature up to the second predetermined temperature.
[0100] Usually, in playback, CPU351 performs fuel addition control which adds a fuel during the exhaust air which flows into a filter 20.
[0101] In fuel addition control, CPU351 distinguishes whether the fuel addition control execution condition is satisfied for every predetermined period. As this fuel addition control execution condition, a filter 20 is in an active state, or the output signal value (exhaust-gas temperature) of the exhaust air temperature sensor 24 is below a predetermined upper limit, poisoning dissolution control is not performed, for example, or the conditions of ** can be illustrated.
[0102] When judged with a fuel addition control execution condition which was described above being satisfied, CPU351 makes temporarily the air-fuel ratio of the exhaust air which flows into a filter 20 a predetermined target rich air-fuel ratio by controlling a flow control valve 30 in order to make a reducing-agent slack fuel inject from the reducing-agent injection valve 28.
[0103] Specifically, CPU351 reads the output signal (accelerator opening) of the engine rotational frequency memorized by RAM353 and the accelerator opening sensor 36, the output signal value (inhalation air content) of an air flow meter 11, fuel oil consumption, etc. Furthermore, CPU351 is accessed to the reducing-agent addition control map of ROM352 by making an engine rotational frequency, the above mentioned accelerator opening and the above mentioned inhalation air content, and fuel oil consumption into a parameter, and computes the addition (target addition) of the reducing agent which is needed when making the air-fuel ratio of exhaust air into the target rich air-fuel ratio set up

beforehand.
[0104] Then, CPU351 is accessed to the flow control valve control map of ROM352 by making said target addition into a parameter, and computes the valve-opening time amount (target valve-opening time amount) of the flow control valve 30 which is needed when making the reducing agent of a target addition inject from the reducing-agent injection valve 28.
[0105] When the target valve-opening time amount of a flow control valve 30 is computed, CPU351 makes a flow control valve 30 open. In this case, since the high-pressure fuel breathed out from the fuel pump 6 is supplied to the reducing-agent injection valve 28 through the reducing-agent supply way 29, the pressure of the fuel impressed to the reducing-agent injection valve 28 reaches more than an injection-valve opening pressure, and the reducing-agent injection valve 28 opens.
[0106] CPU351 will carry out clausilium of the flow control valve 30, if said target valve-opening time amount passes since the time of making a flow control valve 30 open. In this case, since supply of the reducing agent from the fuel pump 6 to the reducing-agent injection valve 28 is intercepted, the pressure of the fuel impressed to the reducing-agent injection valve 28 becomes under an injection-valve opening pressure, and the reducing-agent injection valve 28 closes the valve.
[0107] Thus, when a flow control valve 30 is usually opened only for target valve-opening time amount, the fuel of a target addition will usually be injected into the exhaust air branch pipe 18 from the reducing-agent injection valve 28. And the reducing agent injected from the reducing-agent injection valve 28 is mixed with the exhaust air which has flowed from the upstream of the exhaust air branch pipe 18, forms the gaseous mixture of a target rich air-fuel ratio, and flows into a filter 20.
[0108] consequently, the air-fuel ratio of the exhaust air which flows into a filter 20 will be boiled comparatively, and will repeat Lean and Rich by turns a short period. And the fuel which flowed into the filter 20 will burn according to a catalyst, and a filter 20 will carry out a temperature up.
[0109] Thus, since the temperature of a filter 20 is maintained by the temperature of 600 degrees C or less by setup of a target addition in playback, combustion loss in quantity of the PM can usually be carried out, preventing the heat deterioration by the elevated temperature.
[0110] However, there is a possibility of PM usually burning with the temperature in playback for low temperature, and remaining. PM which burned and remained will narrow the path area of a filter 20 gradually, as shown in drawing 5 (A).
[0111] Then, when the conditions which perform playback on the strength were satisfied, we decided to remove PM which performed playback on the strength which raises the temperature of a filter 20, and usually burned and remained rather than playback.
[0112] the conditions when usually reproducing as conditions which perform this playback on the strength -- in addition -- for example, it is mentioned having usually reproduced the number of predetermined times or that the car ran a predetermined distance, that predetermined time amount has passed since the last playback on the strength, that the discharge of PM computed from an internal combustion engine's load and rotational frequency reached the specified quantity, etc.
[0113] When judged with an on-the-strength playback execution condition which was described above being satisfied, CPU351 makes temporarily the air-fuel ratio of the exhaust air which flows into a filter 20 a predetermined target rich air-fuel ratio by controlling a flow control valve 30 that a lot of fuels than the time of playback should usually be supplied to a filter 20.
[0114] Here, lengthening valve-opening time amount of the reducing-agent injection valve 28, shortening valve-opening spacing as an approach of usually supplying a lot of fuels than the time of playback, etc. are mentioned.
[0115] And CPU351 reads the output signal (accelerator opening) of the engine rotational frequency memorized by RAM353 and the accelerator opening sensor 36, the output signal value (inhalation air content) of an air flow meter 11, fuel oil consumption, etc. Furthermore, CPU351 is accessed to the reducing-agent addition control map of ROM352 by making an engine rotational frequency, the above mentioned accelerator opening and the above mentioned inhalation air content, and fuel oil consumption into a parameter, and computes the addition (target addition) of the reducing agent which is needed when making the air-fuel ratio of exhaust air into the target rich air-fuel ratio set up beforehand.

[0116] Then, CPU351 is accessed to the flow control valve control map of ROM352 by making said target addition into a parameter, and computes the valve-opening time amount (target valve-opening time amount) of the flow control valve 30 which is needed when making the reducing agent of a target addition inject from the reducing-agent injection valve 28.
[0117] Hereafter, a fuel is usually added like playback, and as shown in drawing 5 (B), the temperature up of the temperature of a filter 20 is carried out to 700 degrees C or more.
[0118] At this time, the floor tempereture of a filter 20 is presumed from the output value of the exhaust air temperature sensor 24, and it may be made to perform feedback control of fuel addition.
[0119] Thus, in the filter 20 by which the temperature up was carried out, by playback, ignition combustion of the PM remained [was burned and] and deposited can be carried out, and a filter 20 can usually be reproduced.
[0120] Moreover, since there is a possibility of inducing the heat deterioration of a filter 20 when playback on the strength is performed, as for the execution time of playback on the strength, it is desirable to usually make it shorter than the reproductive execution time.
[0121]
[Effect of the Invention] According to the exhaust emission control device of the internal combustion engine concerning this application, the blinding of a filter is cancelable, controlling the heat deterioration of a catalyst.
[0122] Therefore, it can continue, the function of a filter can be maintained at a long period of time, and aggravation of exhaust air emission can be prevented.

[Translation done.]